

# Mathematics Algebra





# Mathematics

## Algebra

### Outcome

#### Key Growth Point 1

Learners use intentional communication strategies to interact with people, objects and activities.

Learners demonstrating solid evidence of

#### A KGP 1 Algebra

- actively seek and anticipate interactions with familiar people, activities, objects and environments
- use a limited repertoire of gestures, actions and vocalisation strategies to respond to a sensory cue actively

#### KGP 2

Learners reproduce a given repeating physical pattern by copying.

### Indicators

Key Growth Point 1 has three distinct developmental stages organised into six levels. The Key Growth Points Continuum on page two (2) describes the earlier stages of this development, whilst the indicators below provide the curriculum scope for planning and assessing learning within **Key Growth Point 1**.

#### Level 5 Anticipate

- choose from a limited range of responses to seek attention, request and respond to people, materials, objects and activities, eg show excitement or protest when presented with familiar objects, activities, environments; reach out toward a familiar object
- explore materials and objects, eg reach out to explore the position of objects
- seek objects that may not exist in the immediate environment, eg actively look for or request objects
- participate in shared activities with intermittent prompts and cues, eg copy some actions during number rhymes, songs and number games
- sustain concentration for short periods of time
- observe the results of their own actions with interest, eg notice changes in visual or auditory input as a result of touching an object
- remember learnt responses over more extended periods, eg return to or request favourite number games
- make simple choices, eg use a yes/no system when presented with one option or reach for a preferred object when presented with two objects

## Mathematics Key Growth Points Learning Continuum

Awareness	Engagement	Participation
<p><b>Level 1 Tolerate</b> Learners allow themselves to be involved in an activity prompted by a familiar person. Learners are able to</p> <ul style="list-style-type: none"> <li>• produce simple reflex responses in response to the sensations they are experiencing, eg vocalisation, eye rolling, actions in response to feeling pain</li> <li>• produce simple reflex responses in response to external stimuli, eg startle reflex to a loud noise</li> <li>• rely on communication partner to prompt interaction</li> </ul>	<p><b>Level 3 Respond</b> Learners change their body language in a more sustained and consistent way. Learners are able to</p> <ul style="list-style-type: none"> <li>• respond consistently to and show interest in familiar people, events and objects, eg point to known objects or people</li> <li>• react to new experiences, eg move towards an object, sound or movement source</li> <li>• accept and engage in co-active exploration of objects and environments, eg reach out and feel for objects as tactile cues to events</li> </ul>	<p><b>Level 5 Anticipate</b> Learners use intentional communication strategies to interact with people, objects and activities. Learners are able to</p> <ul style="list-style-type: none"> <li>• choose from a limited range of responses to seek attention, request and respond to people, materials, objects, activities, eg show excitement or protest when presented with familiar objects, activities, environments; reach out toward a familiar object</li> <li>• explore materials and objects, eg reach out to explore the position of objects</li> <li>• seek objects that may not exist in the immediate environment, eg actively look for or request objects</li> <li>• participate in shared activities with intermittent prompts and cues, eg copy some actions during number rhymes, songs and number games</li> <li>• sustain concentration for short periods of time</li> <li>• observe the results of their own actions with interest, eg notice changes in visual or auditory input as a result of touching an object</li> <li>• remember learnt responses over more extended periods, eg return to or request favourite number games</li> <li>• make simple choices, eg use a yes/no system when presented with one option or reach for a preferred object when presented with two objects</li> </ul>
<p><b>Level 2 React</b> Learners respond to a stimulus. Learners are able to</p> <ul style="list-style-type: none"> <li>• take part in interactions, activities and experiences through body language, actions, vocalisations, eg attend briefly to lights, sounds or patterns of movement</li> <li>• intermittently appear alert and focus attention on certain people, objects or parts of objects, and experiences, eg focus on sensory aspects of stories or rhymes when prompted</li> <li>• give unexpected or intermittent reactions within an interaction, activity or experience, eg become excited in the midst of social activity</li> </ul>	<p><b>Level 4 Focus</b> Learners respond purposefully to a stimulus. Learners are able to</p> <ul style="list-style-type: none"> <li>• communicate consistent preferences and affective responses, eg reach out for favourite person</li> <li>• recognise familiar people, objects and experiences, eg recall an object that has been placed out of sight</li> <li>• perform actions by trial, error and improvement, eg hit a mathematical shape on a concept keyboard to make it appear</li> </ul>	<p><b>Level 6 Choose</b> Learners request stimulus through gesture, action or vocalisation and are able to make a choice or express a preference. Learners are able to</p> <ul style="list-style-type: none"> <li>• request interactions and activities with consistent use of gesture, actions or vocalisations, eg prompt another person to join in an activity</li> <li>• use learned responses over increasing periods of time to engage in activities and anticipate future events, eg indicate an area of the yard to go to</li> <li>• respond to options presented with actions, gestures and/or vocalisations clearly expressing their preference</li> <li>• attempt to solve problems systematically, eg bring an object to an adult in order to request a new activity</li> <li>• choose to select or reject from a number of presented options within and outside experiences, eg choose to taste new foods</li> </ul>

# Mathematics

## Algebra

### Outcome

#### Key Growth Point 2

##### KGP 1

Learners use intentional communication strategies to interact with people, objects and activities.

Learners reproduce a given repeating physical pattern.

Learners demonstrating solid evidence of

##### A KGP 2 Algebra

- reproduce a given physical pattern by copying the elements in order, one element at a time

##### KGP 3

Learners recognise and continue repeating physical or kinaesthetic patterns.

### Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 2**

#### Knowledge and skills

#### Working mathematically

##### Patterns

- copy repeating patterns

##### Patterns

- copy repeating patterns using sounds; percussion instruments; actions, eg clap, clap, stamp; objects and shapes, eg craft materials, food, beads, toys

##### Relationships

- copy number patterns involving counting forwards or backwards by 1

##### Relationships

- explore counting patterns with songs and rhymes, eg Five Little Ducks, Three Jellyfish
- count small collections, eg children in the group, toys on the mat

##### Representations

- use language to describe patterns

#### Key Mathematical Language

pattern, same, again, copy

# Mathematics

## Algebra

### Outcome

#### Key Growth Point 3

##### KGP 2

Learners reproduce a given repeating physical pattern.

Learners recognise and continue repeating physical or kinaesthetic patterns.

Learners demonstrating solid evidence of

##### A KGP 3 Algebra

- recognise and continue repeating patterns involving manipulatives, shapes or body movement
- count elements to help identify and repeat patterns

##### Band 1

Learners describe physical patterns formed by repeated addition or subtraction of a fixed number of elements or use a simple rule to generate such a pattern.

### Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 3**

#### Knowledge and skills

#### Working mathematically

##### Patterns

- copy, continue or create repeating patterns

##### Patterns

- explore repeating patterns using body percussion, percussion instruments, actions, people, objects, shapes and pictures, eg draw patterns, make patterns with craft materials, use printing to create wrapping paper, arrange class in patterns, use computer graphics




##### Relationships

- continue number patterns forwards and backwards by ones up to 20
- continue number patterns that increase or decrease by twos
- demonstrate an emerging understanding of 'equality' using the words 'is the same as'

##### Relationships

- use physical number lines (ie 'clothes lines') to count forwards and backwards by ones and twos
- enlist rhythmic counting to emphasise counting by twos, ie one, **two**, three, **four**, five, **six**
- use objects to count by twos, eg pairs of socks
- investigate, using equal arm balance, whether two groups have the same number of identical objects and describe as 'the same as'
- use manipulatives or drawings to represent a given quantity in different ways, eg  $\blacklozenge\blacklozenge\blacklozenge\blacklozenge = 4$  or  $\blacklozenge\blacklozenge$  and  $\blacklozenge\blacklozenge$  is the same as 4

##### Representations

- use everyday language to describe patterns with particular attention to the word 'repeat'
- identify and record the number of elements in a pattern, eg  $\blacklozenge\blacklozenge\blacklozenge\blacklozenge$ ; may be labelled as a 'three pattern' or a 'one-two' pattern
- record kinaesthetic patterns using words or pictures, eg clap, clap, stamp; or   

#### Key Mathematical Language

pattern, repeat, repeating, repeated, next, after, before, backwards, forwards, is the same as, equals

# Mathematics

## Algebra

### Outcome

#### Band 1

##### KGP 3

Learners recognise and continue repeating physical or kinaesthetic patterns.

Learners describe physical patterns formed by repeated addition or subtraction of a fixed number of elements or use a simple rule to generate such a pattern.

Learners demonstrating solid evidence of

##### A 1 Algebra

- recognise and continue physical patterns formed by repeated addition or subtraction of a fixed number of elements
- express patterns as a number series by counting elements
- express a number sequence as a physical pattern
- apply simple rules to generate number patterns

##### Band 2

Learners describe physical patterns involving change in the difference between successive numbers.

### Indicators

The curriculum scope for planning and assessing learning within **Band 1**

#### Knowledge and skills

#### Working mathematically

##### Patterns

- continue or create patterns with manipulatives that increase and decrease by 2s, 3s, 5s and 10s
- describe previously explored patterns as number sequences, eg 3, 6, 9,... and also describe using everyday language, eg add 3 each time
- represent a given number sequence using manipulatives
- continue familiar number patterns involving repeated addition or subtraction
- discover missing numbers in previously explored number sequences
- identify odd and even numbers

##### Patterns

- guess the rule that a number machine applies, eg a student posts some counters into a box; another student, in the box, changes the number of counters in a consistent manner (always increasing by 3) and posts the new total of counters back out of the box; students determine the rule the machine applied
- explore patterns formed by odd and even numbers

##### Relationships

- demonstrate an understanding of commutativity in addition
- describe the relationship between addition and subtraction facts, eg  $8 + 3 = 11$  so  $11 - 3 = 8$  and  $11 - 8 = 3$
- explain that when zero is added or subtracted from a number there is no change

##### Relationships

- explore commutativity through the use of manipulatives, eg use two different colours of pegs on a coat hanger (4 red and 2 blue), find the total and turn the coat hanger around to see that 2 blue and 4 red has the same total
- investigate pairs of whole numbers that add to the same total, eg find and order all pairs that equal 9 and identify commutative facts

## Indicators

The curriculum scope for planning and assessing learning within **Band 1 (cont)**

### Knowledge and skills

### Working mathematically

#### Representations

- use number lines, grids and hundreds charts to represent patterns

#### Key Mathematical Language

add, subtract, number line, total, odd, even, number pattern



# Mathematics

## Algebra

### Outcome

#### Band 2

##### Band 1

Learners describe physical patterns formed by repeated addition or subtraction of a fixed number of elements or use a simple rule to generate such a pattern.

Learners describe physical patterns involving change in the difference between successive numbers.

Learners demonstrating solid evidence of

##### A 2 Algebra

- recognise and continue physical patterns formed by repeatedly adding or subtracting a predictably increasing or decreasing number of elements
- express patterns as a number sequence
- generate patterns and number sequences given a description or set of instructions
- continue and complete number sequence patterns involving repeated addition or subtraction
- complete equations involving simple addition or subtraction where one of the elements (addend, minuend or subtrahend) is missing

##### Band 3

Learners describe and continue number patterns involving repeated multiplication or division. They convert a physical pattern or number pattern to a table of values.

### Indicators

The curriculum scope for planning and assessing learning within **Band 2**

#### Knowledge and skills

##### Patterns

- continue or create patterns with manipulatives formed by repeatedly adding a predictably increasing number of elements, eg doubling, triangle or staircase patterns
- describe previously explored patterns as number sequences, eg 2, 4, 8, 16, 32, 64... and describe using everyday language, eg double the last number
- continue or create patterns that increase and decrease by threes, fours, sixes, sevens, eights and nines, and identify missing numbers in the sequence
- generate patterns based on counting by fives and tens beginning with a specific number, eg 6, 11, 16, 21, 26...

##### Relationships

- demonstrate an understanding of commutativity in multiplication
- describe the relationship between multiplication and division facts, eg  $4 \times 3 = 12$  so  $12 \div 3 = 4$  and  $12 \div 4 = 3$
- complete either addition, subtraction, multiplication and division number sentences by calculating a missing number, eg  $\_\_\_ + 8 = 17$ ,  $5 + 2 = \_\_\_ + 3$

#### Working mathematically

##### Patterns

- investigate triangular and staircase numbers use manipulatives, draw diagrams and describe patterns using informal language
- investigate number sequences, eg 4, 8, 16, 32... and describe the pattern using everyday language, eg start with four and double

##### Relationships

- investigate commutativity and the relationship between multiplication and division facts through the use of arrays, eg how many different arrays can be created with 24 counters and how many ways can the arrays be described?
- play 'guess my rule' games, eg function machine

## Indicators

The curriculum scope for planning and assessing learning within **Band 2 (cont)**

### Knowledge and skills

### Working mathematically

#### Relationships (cont)

- investigate odd and even numbers, eg adding and subtracting one, adding two even numbers, adding two odd numbers, adding an odd and an even, finding the difference between two even, finding the difference between two odd, finding the difference between an odd and an even number

### Representations

- use words and tables to record relationships between pairs of numbers, eg initial prices and prices after \$2 discount
- use the equal sign to mean 'is the same as', eg  $4 + 3 = 2 + 5$

### Key Mathematical Language

sequence, position, number, array, multiples, vertical, horizontal, row, column, double, increase, decrease, sum, difference

# Mathematics

## Algebra

### Outcome

#### Band 3

##### Band 2

Learners describe physical patterns involving change in the difference between successive numbers.

Learners describe and continue number patterns involving repeated multiplication or division. They convert a physical pattern or number pattern to a table of values.

Learners demonstrating solid evidence of

##### A 3 Algebra

- recognise, complete or continue number sequence involving repeated multiplication or division by a constant
- convert a pattern to a number sequence and use this to construct a table of values
- complete missing numbers in a given table of values
- precisely describe a number pattern in a way that it could be exactly reproduced

##### Band 4

Learners describe a one or two-operation number sequence symbolically, in terms of a general rule. They use a general rule to determine the  $n$ th term of a sequence or, given the term, determine its position in the sequence. They apply symbolic notation involving the four operations to solve problems.

### Indicators

The curriculum scope for planning and assessing learning within **Band 3**

#### Knowledge and skills

##### Patterns

- continue or create patterns formed by repeated multiplication or division, or identify missing numbers in a sequence
- create a table of values describing physical or visual patterns, ie specifying position number and number of elements
- use a previously described pattern to complete missing values in a table or calculate the value of a number in a given position

##### Relationships

- find a missing value in number sentences involving more than one operation, eg  $5 + \_ = 12 - 4$ ;  $2 \times 5 = 4 + \_$ ; and missing operations, eg  $6 \_ 2 = 4 \_ 4$
- apply order of operations to solve equations

##### Representations

- describe a single operation relationship between values in a table using everyday language, eg 'multiply the first number by 3 to get the second number'

#### Working mathematically

##### Patterns

- investigate number and physical patterns and describe using words and tables; use tables to discover the relationship between pairs of values and calculate other values not represented
- explore a variety of number patterns and describe in everyday language, eg square numbers, triangular numbers, Pascal's triangle, Fibonacci numbers, Lucas numbers 1, 3, 4, 7, 11, 18, 29, 47, 76
- investigate number sequences involving simple fractions and decimals through the use of manipulatives or calculators, eg use repeated addition on a calculator ( $+ 0.25 = =$ ) to generate sequences such as 0.25, 0.5, 0.75, 1, 1.25, ...

#### Key Mathematical Language

brackets, table of values, operations, calculate

# Mathematics

## Algebra

### Outcome

#### Band 4

##### Band 3

Learners describe and continue number patterns involving repeated multiplication or division. They convert a physical pattern or number pattern to a table of values.

Learners describe a one or two-operation number sequence symbolically, in terms of a general rule. They use a general rule to determine the  $n$ th term of a sequence or, given the term, determine its position in the sequence. They apply symbolic notation involving the four operations to solve problems.

Learners demonstrating solid evidence of

##### A 4 Algebra

- recognise, complete or continue a number sequence based on repeatedly applying one or two operations
- convert a number sequence to a table of values and determine a rule linking the value of any term to its position in the sequence
- create and manipulate algebraic expressions and equations involving the four operations in order to determine unknown values and solve problems

##### Band 5

Learners explore and interpret patterns revealed by graphing more complex equations including quadratic functions.

### Indicators

The curriculum scope for planning and assessing learning within **Band 4**

#### Knowledge and skills

#### Working mathematically

##### Patterns

- create or continue number and physical patterns involving one or two operations
  - describe possible different methods of assembling the pattern in words
  - convert the pattern to a table of values
  - use both the descriptions and the table to determine the relationship between pairs of values
  - describe this rule in words and symbolically as an equation
  - use the rule to calculate other values not represented ie, given a position, use the rule to calculate its value; given a value, use the rule to calculate position

##### Relationships

- manipulate or simplify linear expressions by:
  - collecting like terms
  - expanding, eg  $m(m+n) = m^2 + mn$
  - factorising, eg  $a^2 - 6a = a(a - 6)$
- recognise equivalence between different forms of the same expression, eg  $3(a + 2) = 3a + 6$
- solve equations where fractions or simplification are required on only one side, eg  $\frac{x-3}{2} = 4$

##### Patterns

- investigate numeric and physical patterns using words, tables, algebraic equations and graphs

##### Relationships

- use technology and other means to investigate and report on the relationship between the slope of a linear graph, its equation and table of values
- solve equations using a variety of strategies, eg backtracking
- represent word problems algebraically and solve

## Indicators

The curriculum scope for planning and assessing learning within **Band 4 (cont)**

### Knowledge and skills

### Working mathematically

#### Relationships (cont)

- solve equations by substituting specified values for variables, eg  $A = \frac{b \times h}{2}$   
where  $A = 9$  and  $h = 10$
- rearrange a formula to make a specific variable the subject, eg where speed = distance/time ( $s = d/t$ ), rearrange to make time the subject
- solve simple inequalities and represent on a number line, eg  $5y > 14$

#### Representations

- identify features of the number plane, eg x-axis, y-axis, quadrants, origin (0,0)
- use a previously constructed table of values to generate ordered pairs and plot the relationship on a graph
- use a previously derived rule or equation to generate ordered pairs and plot on a graph
- given a linear equation in general form, identify the gradient and y intercept and apply these values to sketch a graph
- given a graph, generate a table of values, identify a pattern and write the rule
- identify y intercept in a given rule, formula or graph
- determine the gradient from a linear equation, table of values or graph (using the formula Gradient = rise / run where applicable)
- from a graph, determine the gradient and y intercept and express as an algebraic equation, ie  $y = mx + c$

#### Representations

- represent a rule or formula graphically using a range of strategies
- use a graphics calculator to investigate and explain the effect of adding a constant to any function
- given a graph including multiple linear equations and a context, use linear features to recreate the story
- investigate the relationship between the table, the graph, the equation, the gradient and y intercept

#### Key Mathematical Language

constant, variable, inequality, formula, simplify, expand, factorise, equation, gradient, rise, run, y intercept, ordered pairs, x-axis, y-axis, quadrants, origin, coordinates, intersection, linear, plot

# Mathematics

## Algebra

### Outcome

#### Band 5

##### Band 4

Learners describe a one or two-operation number sequence symbolically, in terms of a general rule. They use a general rule to determine the  $n$ th term of a sequence or, given the term, determine its position in the sequence. They apply symbolic notation involving the four operations to solve problems.

Learners explore and interpret patterns revealed by graphing more complex equations including quadratic functions.

Learners demonstrating solid evidence of

##### A 5 Algebra

- apply quadratic formulae to generate paired number sequences and represent them graphically
- investigate and interpret linear and quadratic functions and their graphs
- apply algebraic techniques and rules, including index laws and rules involving simultaneous equations and fractions, to simplify algebraic expressions, resolve equations and solve real-world problems

##### Band 5+

Learners explore and interpret patterns revealed by graphing a greater range of complex functions including logs, circles, hyperbolics and exponentials.

### Indicators

The curriculum scope for planning and assessing learning within **Band 5**

#### Knowledge and skills

#### Working mathematically

##### Relationships

- derive and apply index laws:
  - $a^m \times a^n = a^{m+n}$
  - $a^m \div a^n = a^{m-n}$
  - $(a^m)^n = a^{mn}$
  - $a^0 = 1$  ( $a \neq 0$ )
  - $a^{-m} = 1/a^m$  ( $a \neq 0$ )
- apply algebraic techniques to manipulate or simplify expressions including positive, negative or fractional indices, eg  $b^2(b - 7) - b^3$ ;  $3y^{-5} \times 7y^{-3}$ ;  $3p^{1/2} \div 6p^{1/2}$
- manipulate or simplify expressions involving algebraic fractions and common binomial factors
- expand a variety of binomial products, eg  $(5m - 1)(3m + 2) = 15m^2 + 7m - 2$
- solve linear equations where the addition or subtraction of algebraic fractions is required, or where simplification or factorisation is required on both sides, eg  $\frac{2d + 1}{2} = \frac{3d + 11}{4}$
- solve quadratic equations of the form  $ax^2 = c$  therefore  $x = \pm \sqrt{c/a}$

##### Relationships

- investigate numeric and physical patterns or word problems which can be modelled using expressions incorporating indices
- investigate situations involving two relationships, eg identify the better of two mobile phone plans by solving simultaneous equations graphically

## Indicators

The curriculum scope for planning and assessing learning within **Band 5 (cont)**

### Knowledge and skills

### Working mathematically

#### Relationships (cont)

- solve quadratic equations that have real, rational solutions using 'difference of squares' method, ie  $a^2 - b^2 = (a + b)(a - b)$
- solve equations for a purpose using substitution and transposition, including the manipulation of indices and roots, eg apply to formulae such as  $V = \frac{4\pi r^3}{3}$
- solve inequalities, eg  $\frac{2t + 5}{5} > -3$
- create graphs for two functions to find a common solution to two linear equations (simultaneous equations)
- solve linear equations algebraically where they yield to straightforward substitution, eg  $3x + y = 17$   
 $5x - y = 7$

#### Representations

- explain and apply the midpoint formula to determine the midpoint of an interval joining the points  $(x_1, y_1)$  and  $(x_2, y_2)$  on a number plane, ie  $M(x, y) = \sqrt{\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)}$
- determine the length of a defined interval on a linear graph by treating the interval as the hypotenuse of a right angled triangle and applying Pythagoras' theorem
- explain and apply the midpoint formula to determine the distance between two points  $(x_1, y_1)$  and  $(x_2, y_2)$  on a number plane, ie

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- explain and apply the gradient formula to determine the gradient of an interval joining the points  $(x_1, y_1)$  and  $(x_2, y_2)$  on a number plane, ie

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

#### Representations

- use a graphical calculator to investigate the effect of changing the value of either the coefficient 'a' or the constant 'c' in the equation  $y = ax^2 + c$  on the resulting graph for a given set of x values
- investigate numerical and physical patterns or situations which can be modelled and graphed using quadratic expressions, eg everyone shakes hands once with everyone else at a meeting; there were 66 handshakes, how many people were there?

## Indicators

The curriculum scope for planning and assessing learning within **Band 5 (cont)**

### Knowledge and skills

### Working mathematically

#### Representations (cont)

- transpose linear equations into the general form  $y = mx + c$  in order to determine the gradient and y intercept and sketch as a graph
- graph relationships of the form  $y = ax^2 + c$  by generating a table of values and plotting ordered pairs
- describe the effect on the graph of increasing or decreasing the value of 'a'
- describe the effect on the graph of changing the value of 'c'

#### Key Mathematical Language

expression, parabola, hyperbola, midpoint, index laws, indices, binomial, trinomial, quadratic, interval



# Mathematics

## Algebra

### Outcome

#### Band 5+

##### Band 5

Learners explore and interpret patterns revealed by graphing more complex equations including quadratic functions.

Learners explore and interpret patterns revealed by graphing a greater range of complex functions including logs, circles, hyperbolics and exponentials.

Learners demonstrating solid evidence of

##### A 5+ Algebra

- determine general connections between aspects of various formulae and their graphical properties and apply this knowledge in order to sketch graphs of a range of functions
- apply a wider range of algebraic techniques and rules, including log laws, to investigate graphs of functions and inequalities and solve problems

### Indicators

The curriculum scope for planning and assessing learning within **Band 5+**

#### Knowledge and skills

#### Working mathematically

##### Relationships

- solve quadratic equations that have real, rational solutions by applying a variety of methods including factors, perfect square and completing the square
- transpose quadratic equations to the form  $ax^2 + bx + c$  in order to solve
- use the general quadratic formula to solve equations where irrational solutions exist or to determine if there are one, two or no real solutions
- solve simultaneous equations requiring some algebraic manipulation, eg  
 $2w = 7 + 3u$   
 $4u + 15 = -3w$
- solve linear inequations where the direction of the inequality must be changed, ie a multiplication or division by a negative term is required
- simplify expressions involving the substitution of complex terms for variables, eg simplify  $4x^2 - 5a^2$  where  $x = 3a$
- factorise and simplify a variety of expressions, including those incorporating trinomials, eg  
 $3y^2 - 5y - 2$   
 $(y - 2)$
- $a^{1/n} = \sqrt[n]{a}$

##### Relationships

- investigate numerical and physical patterns or situations which can be modelled and graphed using quadratic expressions, eg a 22 metre length of fencing is used to make a rabbit run; the wall of a long shed is used as one side of the rectangular run. Determine the dimensions of the run that would give the greatest area.

## Indicators

The curriculum scope for planning and assessing learning within **Band 5+ (cont)**

### Knowledge and skills

### Working mathematically

#### Relationships (cont)

- transpose equations for a purpose, including those requiring the manipulation of reciprocals, eg make 's' the subject of

$$\frac{1}{x} = \frac{1}{r} + \frac{1}{s}$$

#### Representations

##### Linear

- determine the equation of a line of a given gradient  $m$  passing through point  $(x_1, y_1)$ , ie explain and apply the formula  
 $y - y_1 = m(x - x_1)$
- determine the  $x$  and  $y$  intercepts from a linear equation and so sketch the graph, ie determine  $y$  when  $x = 0$ , determine  $x$  when  $y = 0$
- determine the equation of a line that is parallel to a given line
- determine the equation of a line that is perpendicular to a given line
- indicate the region defined by one or more linear inequations on a Cartesian plane by graphing
- determine if a given point lies in a region defined by a linear inequality without graphing

##### Non Linear

- find the  $x$  intercept/s of a given quadratic by factorising the equation or using the general quadratic formula
- state the  $y$  intercept of a given quadratic directly from the equation
- determine the axis of symmetry of a given quadratic by finding the midpoint of the interval bound by the  $x$  intercepts, or by using the formula  $x = -b \div 2a$
- find the turning point of a quadratic, either by substituting in the  $x$  value provided by the axis of symmetry or by completing the square

#### Representations

##### Linear

- present a logical argument explaining why the product of the gradients of two perpendicular lines is  $-1$

##### Non Linear

- investigate numeric and physical patterns which can be modelled using exponential equations, eg repeatedly fold a paper strip in half, then in half again as many times as possible, note the relationship between the number of folds ( $n$ ) and the number of sections ( $s$ ) defined by the folds, describe as a formula or a graph
- graph exponential relationships of the form  $y = ax$  and their inverse relationships  $y = \log_a x$  on the same set of axes and describe the relationship between the two graphs
- present a logical argument explaining the general form of a circle based on the application of Pythagoras' theorem

## Indicators

The curriculum scope for planning and assessing learning within **Band 5+ (cont)**

### Knowledge and skills

### Working mathematically

#### Non Linear (cont)

- sketch a quadratic relationship by using the equation to determine the intercepts, turning point and sign
- graph hyperbolic relationships of the form  $y = a/x$  by generating a table of values and plotting ordered pairs
- graph exponential relationships derived from patterns or problems
- recognise and graph equations describing circles whose centre is the origin, ie  $x^2 + y^2 = r^2$
- state, without graphing, if given equations will result in lines, parabolas, hyperbolae or circles and justify decision

#### Key Mathematical Language

real, unreal, rational, irrational, reciprocal, hyperbola, exponential, logarithm